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REFURBISHMENT OF AN ULTRAVIOLET & ELECTRONIC SPECTROMETER & PHOTOMETER

ROBERT S. HILLS

TRI-CON ASSOCIATES, INC.
765 Concord Avenue
Cambridge, MA 02138

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AIR FORCE GEOPHYSICS LABORATORY
AIR FORCE SYSTEMS COMMAND
UNITED STATES AIR FORCE
HANSCOM AFB, MASSACHUSETTS 01731

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Director, Space Physics Division

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Modification and field services for instruments launched on rocket from WSMR, New Mexico, 19 April 1983. Modification of shuttle Electron Spectrometer. Design, fabrication and launch services for Electron Spectrometer on PIIE project launched on rocket from Sondrestrom Air Base, Greenland 14 March 1985.

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SUMMARY OF CONTRACT OBJECTIVES

The objective of this contract is the modification, refurbishment and flight preparations of the electronic sections of a Solar Extreme Ultraviolet Spectrometer, Electron Analyzer, and Ultraviolet Dayglow Photometer which have already been flown on a rocket and recovered. The electronics includes the ground support equipment (GSE) used to operate the instruments in the laboratory during calibration and the various acceptance and qualification tests.

Additional services were supplied during integration of the instruments with the solar pointing control and telemetry system at Ball Aerospace Systems Division, Boulder, Colorado and also during launch at White Sands Missile Range, New Mexico.

An amendment to the contract calls for modification of the electronics for an Electron Spectrometer built by TRI-CON ASSOCIATES, INC. and flown on the space shuttle. The updated instrument is ready for a future shuttle flight.

An additional amendment calls for modification of the electronics for an Electron Spectrometer built by TRI-CON ASSOCIATES, INC. and flown on a rocket in 1983 as part of the RS 60C instrument. The updated instrument is part of the PIIE project and was launched in March 1985.

1.0 INTRODUCTION

The electronic sections of three distinct instruments have been reworked.

The largest is the double deck solar Extreme Ultraviolet Scanning Spectrometer which has four detector channels on each of the two decks.

The electronics for the top deck was left "as is", since the new requirements are the same as the old, namely, each of the four detectors scanning approximately one quarter of the required wavelength coverage to give continuous coverage from 55Å to 310Å at the rate of 10 steps/second.

The bottom deck electronics has been modified to step at 100 steps/second and the detectors and amplifiers have been removed from the old detector carrier and installed on a new carrier which positions the four detectors for continuous wavelength coverage from 220Å to 1100Å.

The Electron Analyzer instrument is mounted on the large solar pointed EUV Spectrometer and its electrical interface is with the EUV Spectrometer. Its aperture faces away from the sun.

The Electron Analyzer has been modified by the addition of a second analyzer sensor. New stair-

case voltages were required to activate both units and a second counter/shift register was added to process the output of the second analyzer.

The Dayglow Photometer which mounts in a separate rocket section below the solar spectrometer, required minor changes in the filter position monitoring circuit to handle an additional filter.

2.0 INSTRUMENT SPECIFICATIONS

2.1 Solar Spectrometer

Specifications for Top Deck: Four (4) detectors 55Å to 310Å, 1200 lines/mm grating, 1400 steps/scan at 10 steps/second, scan time 140 seconds.
0.22Å FWHM.
Entrance and exit slits 0.0508 mm.
The existing top deck and electronics meet the above specifications and no modification was required.

Specifications for Bottom Deck: Four (4) detectors 220Å to 1100Å, 300 lines/mm grating 5200 steps/scan at 100 steps/second, scan time 52 seconds.
0.43Å FWHM.
Entrance and exit slits 0.25 mm.

The existing bottom deck had detectors scanning about 4 given wavelengths and stepped 10 times a second.

A detector carrier with the required detector configuration for the new specifications is available and the detectors and amplifiers have been transferred to it. The electronics as originally built could operate at either 10 or 100 steps/second by change of a single jumper wire. It has now been connected for 100 steps/second. The motor step logic has been modified to operate a different motor and gear reduction assembly to give the correct step motion for the new instrument resolution of 0.43Å FWHM. The wavelength position readout, which is set in when the scan reverses at the long wavelength end of the scan, has been set to 5200.

A post-flight calibration done after recovery in 1979 had indicated that one of the bottom deck detectors was not active. A Keithley Electrometer, which can measure very high resistance was taken from TRI-CON to AFGL and used to check the resistance of all the channel photomultiplier detectors on both decks. All eight units had approximately the same resistance of 0.9×10^9 ohms. It was concluded that all the photomultipliers are physically intact and should work if the electronics is functional.

The console for the solar spectrometer was originally designed to operate at both 10 steps/second and 100 steps/second so it works with modified instrument.

2.2 Electron Analyzer

The Electron Analyzer is now a double instrument. There are two analyzer assemblies with the electronics for both housed in the original box. The step timing is the same for both channels so there is a common timer but separate PCM frames. Another telemetry channel will be needed.

The present electronics box contains two circuit cards and two power supplies. The power supplies have been removed for use on the shuttle experiment so they have been replaced with new units. Another supply has been added external to the box to supply the voltages needed for the second analyzer.

The counter/shift register circuit card has been replaced by a new card which has two channels instead of one. This is possible since new integrated circuit chips are available which have dual counters in the same chip.

The existing step generator/timer card has been modified to produce all the staircase voltages for the two analyzers.

The timer section of the card is unchanged. The original step generator is used for the low

energy staircase and also is amplified to drive the new higher energy analyzer. Both staircases are in synchronism and have the same percentage increase of four percent at each step.

Specifications for the energy steps are:

Channel 1	0.5 eV to 7.6 eV in 64 steps, 4.418% increase/step, instrument factor 1.25, .: step range = 0.20V to 2.047V, 50 steps/second.
Channel 2	3.5 eV to 53 eV in 64 steps, 4.418% increase/step, instrument factor 1.25, .: step range = 1.4V to 21.3V, 50 steps/second.

The decision to merely modify the original step generator card was arrived at after considering other alternatives.

A new card could be made implementing the staircase generator by means of 6 cascaded operational amplifier stages whose feedback resistors are varied by 6 analog switches controlled by the status of the stages of a six stage binary counter. This method of logarithmic step generator is presently used in another electron

analyzer being built by TRI-CON ASSOCIATES. Another method of step generation is to use the output from a read-only-memory (ROM) which has the correct step voltages in its memory. A third method which looks simple and promising is to make use of Analog Devices AD7111 logarithmic D/A converter. This device can attentuate an analog signal over a large range in 0.375dB steps. These steps are in a encoder disc rotating with the filter wheel. The pattern ratio of 1.044 to 1 (0.375dB) which happens to be the value required for this instrument. However, since the above alternatives require a complete new board along with circuit design and breadboarding it has been decided to stay with the original card.

2.3 Dayglow Photometer

Bit 13 on the PCM data frame will now indicate (when up) that the data count readout in the same frame in bits 17 through 32 represents data taken when the filter is at rest in the proper position in front of the detector. When bit 13 is down the data is in error since the filter is moving and is not completely in front of the detector. Bit 13 circuitry is driven from a contact which is grounded by an encoder segment only when the filter is in place. The circuit allows bit 13 to go up only after the

filter has been in place at least one frame time (100 ms) thus, insuring correct filter position for the entire frame counting time. The data processing computer will be programmed to process only data occurring in frames which have bit 13 up.

Bits 14, 15, and 16 of the PCM frame indicate which of the five filters is in use. These bits are driven from the encoder disc rotating with the filter wheel. The pattern produces 5 combinations of 3 bits as follows: 000, 001, 011, 110, 100. The assignment of code to a particular filter was then accomplished. The above codes are produced by grounding the commutator pattern. The brushes connected to the bit inputs are held high and go low when in contact with the grounded encoder segment.

To provide quick look data reduction in the field after launch the GSE console will decode the count data and display it on an LED digital readout. It will also drive a printer or an analog strip chart recorder. When data is bad (filter out of position) the LED readout is blanked, the printer shows zeros, and the strip chart deflection is zero. A console switch also allows all data, good and bad, to be displayed.

Since the filter drive system is a geneva

movement and now must go through 5 instead of 4 motions to complete the filter cycle, the gearmotor in the filter drive system will have its gear reduction ratio decreased from about 33:1 to 22:1 to maintain the elapsed time of 2.5 seconds for the filter cycle. The part number for the new TRW Motors, Type SS Planetary Gearmotor is 43A141-1.

2.4 Ultraviolet Normal Incidence Spectrometer

A normal incidence spectrometer was mounted in the existing rocket extension can which originally contained the Dayglow Photometer. The new instrument has three assemblies - a detector, counter and scan motor drive electronics, and telemetry interface electronics.

The first two items are mounted on the door of the extension can with the detector looking in approximately the same direction as the photometer aperture. The telemetry interface box is in the can.

The instrument makes 200 wavelength steps/second, accumulating photon counts during the 5 millisecond step time and at the same time shifting out to telemetry the digital representation of the counts collected in the previous step. The PCM frame for the instrument thus occurs 200

times a second and contains a 16 bit sync word, 15 bits of binary count, and a single bit indicating scan reversal, for a total of 32 bits. Thus, the bit rate which must be telemetered is 6400 bits/second.

The telemetry interface electronics generates the system clock and logic gates needed by the counter and motor drive electronics, as well as generating the sync word and combining it with the count data word to produce the 32 bit PCM data format which is fed to the telemetry subcarrier oscillator input.

The existing extension can harness was modified by BASD to provide electrical interface with the new instrument. The instrument power can come from the same battery that is supplying power to the photometer; about 225 ma at 28 volts is required. The power will be applied soon after the door is opened.

3.0 TELEMETRY

The instrument bit rates and channel assignments are as follows:

Instrument	Bit Rate	Channel
Solar Spectrometer		
Top Deck	960 bits/second	16
Bottom Deck	9600 bits/second	H
Electron Spectrometer		
Channel 1	2400 bits/second	18
Channel 2	2400 bits/second	17
Photometer	320 bits/second	12
Normal Incidence Spectrometer	6400 bits/second	19
Instrument Commutator	0.5 bits/second	10

4.0 VIBRATION TESTS AND LAUNCH

4.1 Solar Spectrometer

The Solar Spectrometer with the Electron Spectrometer mounted to it, was vibrated at the AFGL facility on 23 March at a level of 5G, random on each of the three axes. A broken test pulse lead to the bottom deck was found and repaired.

Overall operation in the calibration vacuum tank was confirmed after the shake test. After the vacuum test, oil from the pumping system

was found on the grating. The grating was carefully cleaned by R. Salter and the instrument transported by him to BASD for integration with the pointing control. After successful integration the spectrometer was returned to AFGL, the grating replaced with a spare one, and a short calibration check made. The instrument was then taken to WSMR for launch (see below).

Good flight data were recorded on all channels except the long wavelength channel of the bottom deck. (1000Å to 1200Å). The detector of this channel had produced spurious counts due to high voltage arcing.

4.2 Photometer

The complete photometer was vibrated on 18 May at AFGL and no damage occurred. It was hand carried to BASD, integrated with the extension can, and then removed for shipment to WSMR. The can was returned to Wentworth Institute for addition of an additional door latch and then transported to WSMR.

The instrument performed well during flight. A real time look at data was provided in the block-house to confirm operation.

A strip chart of the counts from each filter

channel was provided by TRI-CON after return to AFGL. This was produced from the flight tape and equipment mentioned above. The photometer console eliminated the counts registered when the filters were changing position and displayed on the strip chart only that data taken when each filter was stationary and in proper alignment. This strip chart confirmed that the instrument operated satisfactorily in flight.

5.0 FIELD SUPPORT FOR RS60C LAUNCHED 19 APRIL 1983

TRI-CON ASSOCIATES, INC. provided field support during integration of the flight instruments with the BASD portion of the rocket payload at Boulder, Colorado.

The ground support equipment, consisting of tools, spare hardware parts, and the vacuum pumping system was shipped ahead by van and the consoles and instruments themselves were hand carried by air by TRI-CON and AFGL personnel on 27 and 28 March.

After arrival each instrument was bench checked using its own individual test console.

BASD fabricated an updated interface cable for the pointed instruments. TRI-CON updated drawings showing the interface of all experiments with the rocket wiring.

The extension can components were installed in the can and tests made to confirm proper operation. The experiments performed correctly, but, some difficulty was encountered with the MIDAS aspect system.

The complete extension can assembly was subjected to a shock and vibration test on the BASD facility. The assembly, including the experiments, survived the 25G shock and 3G random vibration tests.

The payload was then built up in flight configuration and a performance check including telemetry was run on the evening of 31 March. The instruments were removed from the pointing control and extension can and hand carried back to AFGL on 1 April. The extension can was also returned for installation of the additional door latch.

Personnel arrived at White Sands Missile Range on 11 and 12 April to prepare for the 19 April launch. The following schedule was determined:

Horizontal Check	14 April 1330 Hours
Pre-Fire Conference	15 April 0830 Hours
Rocket To Tower	16 April 0900 Hours
Vertical Check	18 April 1000 Hours
Launch	19 April 1250 Hours

On 13 April all instruments were bench checked and found to be operating correctly. The horizontal check was made the next afternoon after a delay in assembling the payload. All instruments and telemetry worked correctly. However, the experiment housekeeping commutator stopped functioning at +343 seconds. The cause could not be determined and the defective unit was replaced with a spare one.

On Friday morning the pre-fire conference was conducted by L. C. Briggs in the Navy building. Launch was confirmed for 1250 hours 19 April.

Friday afternoon the horizontal check tapes were played back by the telemetry group at the VAB and a closer look was taken at the data to make sure the equipment was ready for final rocket build up. The telemetry channels did have adequate bandwidth to provide a good waveform for data recovery.

The mechanical alignment of the optical axis of the pointing system with the spectrometer axis was checked by actually operating the complete pointing system and spectrometer in the sun and observing that sunlight impinged on the grating.

The spectrometer covers and protection grid

assemblies were checked and conducting tape applied on all non-conducting surfaces to prevent charge-up and consequent distortion of the electric field near the electron spectrometer aperture.

Saturday morning the complete rocket and booster was installed in the tower. The vacuum pumping system was put in place on the upper level adjacent to the nose cone which is subjected to a vacuum before launch to remove contaminants and insure fast evacuation to a clean vacuum after launch. The contact pins on the pullaway cables were very corroded and required cleaning, which was done by BASD personnel.

At 1600 hours an instrument check from the consoles in the block-house showed all instruments were operational. The instrument flight battery, which is TRI-CON's responsibility was still at 30 volts after use in the horizontal check and was not recharged for the vertical check.

The vertical check was performed at 1030 hours Monday, 18 April. Again all instruments operated correctly, but, the spare commutator failed as had the other commutator during the horizontal check. A decision had previously been made to launch without the commutator since it monitors only prior supplies and no data would be lost.

The flight battery was recharged after the vertical check. The playback of the telemetry recorded during the check indicated correct instrument operation and a good signal for reduction of the flight data.

The rocket was fueled in the afternoon. The payload was "buttoned up" for flight and a final instrument check was made at 2030 hours.

The rocket was launched at 1315 hours 19 April, after four holds because of strong winds aloft. The countdowns were smooth. The solar spectrometer top deck scanner was reset to the long wavelength end of the scan between runs, so that when the instrument is turned on at -225 seconds and runs through lift off and ascent, the scanner will be at the correct position to insure a complete 135 scan around apogee.

The rocket performed well reaching an altitude of 203.5 kilometers at 236 seconds.

The instruments operated correctly except for high voltage arcing on the long wavelength detector of the bottom deck of the solar spectrometer (1000Å to 1200Å). There was also some arcing on detectors 2 and 3 on the upper deck but it cleared up before apogee was reached and good data were collected for the complete down-

ward leg of the trajectory.

A quick look at the data was provided soon after the flight by playback of the data tapes at the VAB. The various consoles were used to strip out and display the data.

The payload was recovered intact. Instruments were removed and operated on the bench. They were hand carried to AFGL for further checking and post calibration.

6.0 MODIFICATION OF SHUTTLE ELECTRON SPECTROMETER ELECTRONICS AND GROUND SUPPORT EQUIPMENT

The specification for the updated instrument is as follows:

Energy Range to 1 Kev
64 Steps at 12% Increment
10 Steps Per Second

The new 1 Kev energy range requires the step generator to go to plus 400 volts and minus 400 volts instead of the 40 volts. Two 500 volt power supplies have been installed in the original electronics box. They increased the box weight by about 0.5 pounds and the input current by 120 ma.

The step generator board has been replaced with a new board which gives the required step voltages.

Another command relay has been added to the buffer board so that the high voltage can be turned on by command even if the aperture plate is in the sun.

In addition to the new 500 volt power supply, a new $\pm$ 15 volt supply and a new 3000 volt supply have been installed. Thus, the reworked electronics has all new power supplies.

The console data decoder has been modified to run at 10 steps per second and show the binary data count per step by means of the 18 lamps on the front face of the console chassis.

The "Step Control" panel switch has been changed to control both the stepping and both commands. (Test pulse on and H.V. on).

7.0 ELECTRONICS FOR ELECTRON SPECTROMETER FOR PIIE PROJECT

The equipment, which includes one low voltage power supply, three high voltage power supplies, a step generator, two high voltage step amplifiers and monitors, two counters, a test oscillator, and a system timer is housed in a six inch by six inch by four and one-quarter inch box.

The output to telemetry consists of a sixty-four bit PCM main frame divided in four sixteen bit words. The bit rate is thirty-two hundred bits per second, or fifty frames per second. The format is given in Figure 1. It will be transmitted on subcarrier Channel 17.

Word one is the normal sixteen bit sync word.

The sensor counts accumulated in twenty milliseconds during each energy step, are given in words two and three as binary coded decimals (BCD) with the most significant digit readout first.

The first eight bits of the fourth word are the binary representation of the energy steps at which the counts in words two and three were collected. As there are only thirty-two steps, only five bits are required, so bits one, two, and three of the fourth word are always. 0.

The last half of the fourth word is divided in four analog monitors, each two bits wide. The first two analogs are proportioned to the plus and minus energy step voltages applied to the sensors and should vary between approximately 0 and four volts as the sensor energy levels step from twenty ev to two thousand ev. The third analog is a composite monitor of the out-

put of the plus and minus 15 volt power supply and should read about three volts. The fourth analog is a monitor of the twenty-eight hundred volt power supply output used to energize the channel electron multiplier and should read about 3.7 volts with both sensors connected.

A nine pin connector on the electronics box feeds signals to the Sussex University correlators as follows:

Pin 1	-	Ground
2	-	Up Detector Pulses
3	-	Down Detector Pulses
4	-	Sweep Reset
5	-	Step Energy
6,7,8,9,	-	No Connection

The "up" and "down" detector pulses are fed directly from the Amptek A101 amplifiers. The sweep reset and step signals are five volt positive pulses of ten to fifteen microsecond duration.

Schematics are shown in Figures 1,2,3,4. Wiring is shown in Figure 5. The console timing is shown in Figure 6. The instrument timing is shown in Figure 7.

The flight equipment was delivered to AFGL. Paul Gough of Sussex University delivered the

Sussex correlator at the same time (November 5,). The units were checked out together and performed correctly.

The equipment was installed on the payload rack on November 8. It operated correctly. However, the delayed 28V power to energize the detectors and sweep, was programmed to latch a relay instead of being kept on for the remainder of the flight time. Northeastern University will modify the computer program so that the delayed 28V power will be on and stay on from about 80 seconds after launch until end of flight.

A successful "all up" check, which included simulated launch procedure, was performed. The door over the spectrometer aperture was blown open and the delayed 28V power did come on at the right time. The telemetry receiver display showed correct operation of the spectrometer.

The complete payload was vibration and shock tested at Acton Laboratories on November 17. The spectrometer did not suffer damage and operates correctly after the test.

The spectrometer units (two sensors and the electronics box) were then installed in the vacuum calibration system. Instrument response was observed from both sensors.

However, after 80 minutes of operation, there was a failure of a chip in the telemetry multiplex circuit in the electronics box. The chip was replaced by one which could withstand a higher temperature. For further calibration only the sensors were placed in the vacuum and they were operated from external power supplies without use of the electronics box.

After successfully solving problems associated with the vacuum system, the calibration source, and replacement of the sensor amplifiers, the calibration was completed on November 29. The computer calibration results are on file at AFGL.

The instrument was given a final checkout on the bench on November 30. The monitor readings are :

$\pm$ 15V	2.95	volts
H V	3.7	volts
+ sweep(max)	3.8	volts
- sweep(max)	3.8	volts

Low Voltage current = 85 ma.

Low + high voltage current = 420 ma (step 0).

= 370 ma (step 31).

It was then packed for shipment to the launch site at Sondrestrom AB, Greenland.

8.0 TRIP REPORT

Launch of Dual Sensor Electron Spectrometer as part of Project PIIE.

The dual sensor electron spectrometer was launched on a Black Brant Vehicle (A21.426) from Sondrestrom Air Base Range, Greenland at 23:02:32 hours March 14, 1985 as part of a multi-experiment payload to measure conditions in an aurora. Good data was obtained.

The electron spectrometer consisted of two similar electro-static analyzers controlled by a common electronics system. One sensor was mounted at the aft end of the payload to look directly aft along the centerline of the rocket. The other sensor pointed forward at an angle of 45 degrees from the centerline. The rocket's attitude was controlled so that its axis continually pointed along its line of flight. The PCM data from both sensors was telemetered to the ground receiving station on IRIG FM/FM channel 17 (52.5KH_2 center frequency).

The instrument, which had been calibrated at AFGL, and the console was shipped to Sondrestrom in February. R. Hills arrived on 28 February. A Jamesway hut was used as the build-up facility. The equipment was unpacked and console operation

confirmed. A successful bench check of the instrument was made on 1 March.

On 2 March the instrument was assembled on the payload rack and final high voltage connections made to the sensors. The payload rack was inserted into the rocket skin and attached to the end of the remainder of the payload. A quick look check of telemetry was made by hard wiring the telemetry RF signal from the Jamesway to the telemetry van. The channel 17 discriminator output was hard wired back to the Jamesway and the PCM frame, shown in Figure was displayed on a scope.

Since the instrument must be at a good vacuum when the high operating voltage for the channel electron multipliers is turned on at 83 seconds after launch, it is imperative that instrument be very clean. Therefore, the rocket section containing the instrument is constructed to be vacuum tight, but with an ejectable door over the up-looking sensor. A rough vacuum is pulled on the section until an hour before launch. The pump is then removed and the section flushed continually with nitrogen until lift off. Separation of the payload and ejection of the door occur at 63 and 65 seconds respectively, thus giving 18 seconds for outgassing before

High voltage comes on at 83 seconds.

R. Salter of AFGL evacuated the instrument section successfully before rocket build-up, obtaining a vacuum of about 10 microns.

A full all-up telemetry check was successfully performed on 4 March. All experiments operated correctly and there was no interference between them. On 5 March a complete simulated flight sequence was performed and the telemetry system radiated to the nearby telemetry van.

The received and decoded signals were hardwired to the Jamesway hut. The electron spectrometer as displayed on the scope was correct and also the Sussex University correlator performed correctly, going through its 4 second turn-on check.

On 7 March the completely assembled payload was mated to the Black Brant rocket which had already been hung on the launcher rail.

An instrument check was made on the morning of March 8. Telemetry was radiated from the rocket on the rail to the van near the control center and Jamesway. The PCM signal was hardwired to the Jamesway and displayed on the scope. The correlator signal was also displayed on a strip chart.

A dress rehearsal was held the afternoon of March 8, in preparation for the opening of the window March 9. The instrumented airplane which would be in the area to observe the aurora during launch left Pease Air Base later than expected and did not arrive at Sondrestrom until 10 pm. With no aurora present it continued on to Thule so the launch was postponed to the next evening. Prior to each launch attempt the electron spectrometer rocket section was evacuated by the roughing pump which had been moved adjacent to rocket on the rail. Pressures as low as 1 micron were obtained before removing the pump.

A second hot run was performed on the evening of March 10 between 8:30 pm and 11:00 pm local time. However, no satisfactory aurora appeared.

Hot run #3 was performed on March 11 between 8:15 pm and 11:00 pm with no suitable aurora present.

No launch was possible on Tuesday, March 12 because of high winds. On Wednesday, March 13 the conditions were satisfactory for launch at Sondrestrom, however, bad weather at Thule prevented use of the airplane. On Thursday, March 14 conditions were satisfactory and a Hot Run #4

was begun at 6:30 pm. The airplane arrived on station for an 8:30 launch but no aurora was present. The count was held at minus 5 minutes and 30 seconds. Just before 11:00 pm the launch window was extended to 11:30 pm as conditions were improving.

The count was picked up at 11:00 pm as an aurora was approaching. The rocket lifted off at 11:05 and 52 seconds, and performed well, reaching an apogee of 429 km at 11:11 and 32 seconds.

Data was present on the electron spectrometer telemetry from high voltage turn-on at 83 seconds at an altitude of about 140 km to about 630 seconds when the rocket was below 90 km.

The correlator operated correctly but it is impossible to tell if correlation did occur without reducing the data.

There was no attempt at recovery of the instrument. The vacuum pumping equipment was moved to a hanger of the Air National Guard to await shipment to White Sands Missile Range for use on the BERT I launch scheduled for May.

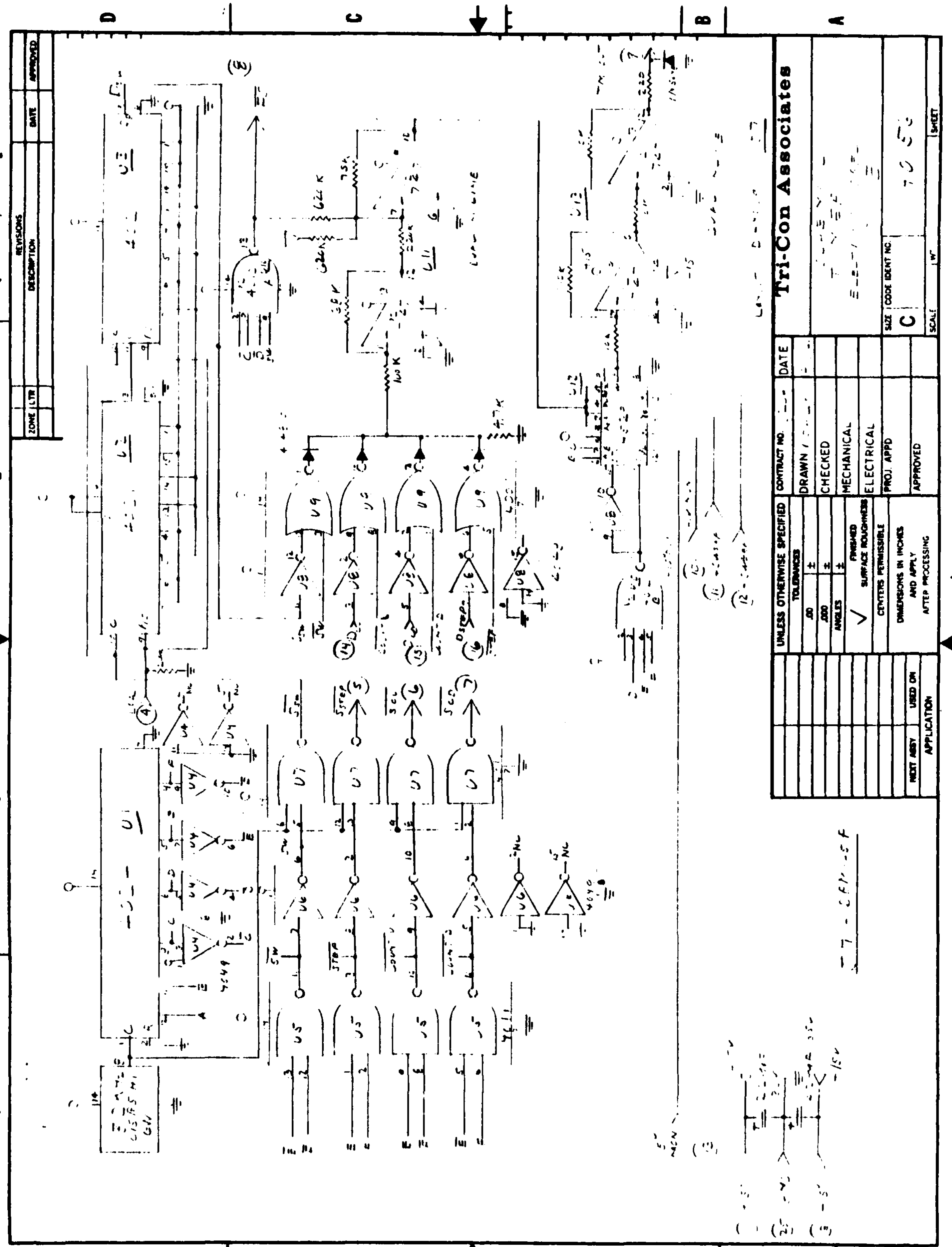
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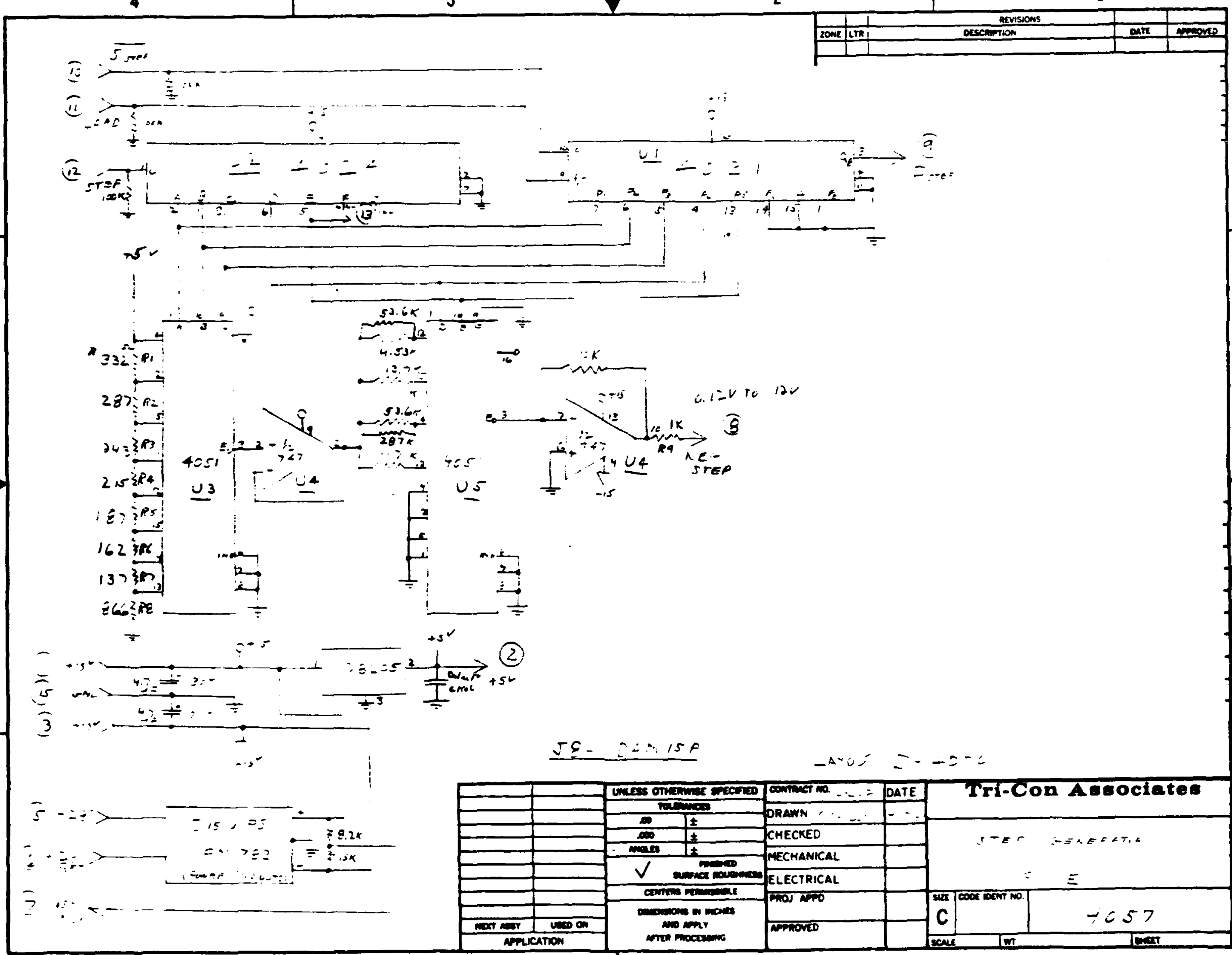
Figure 1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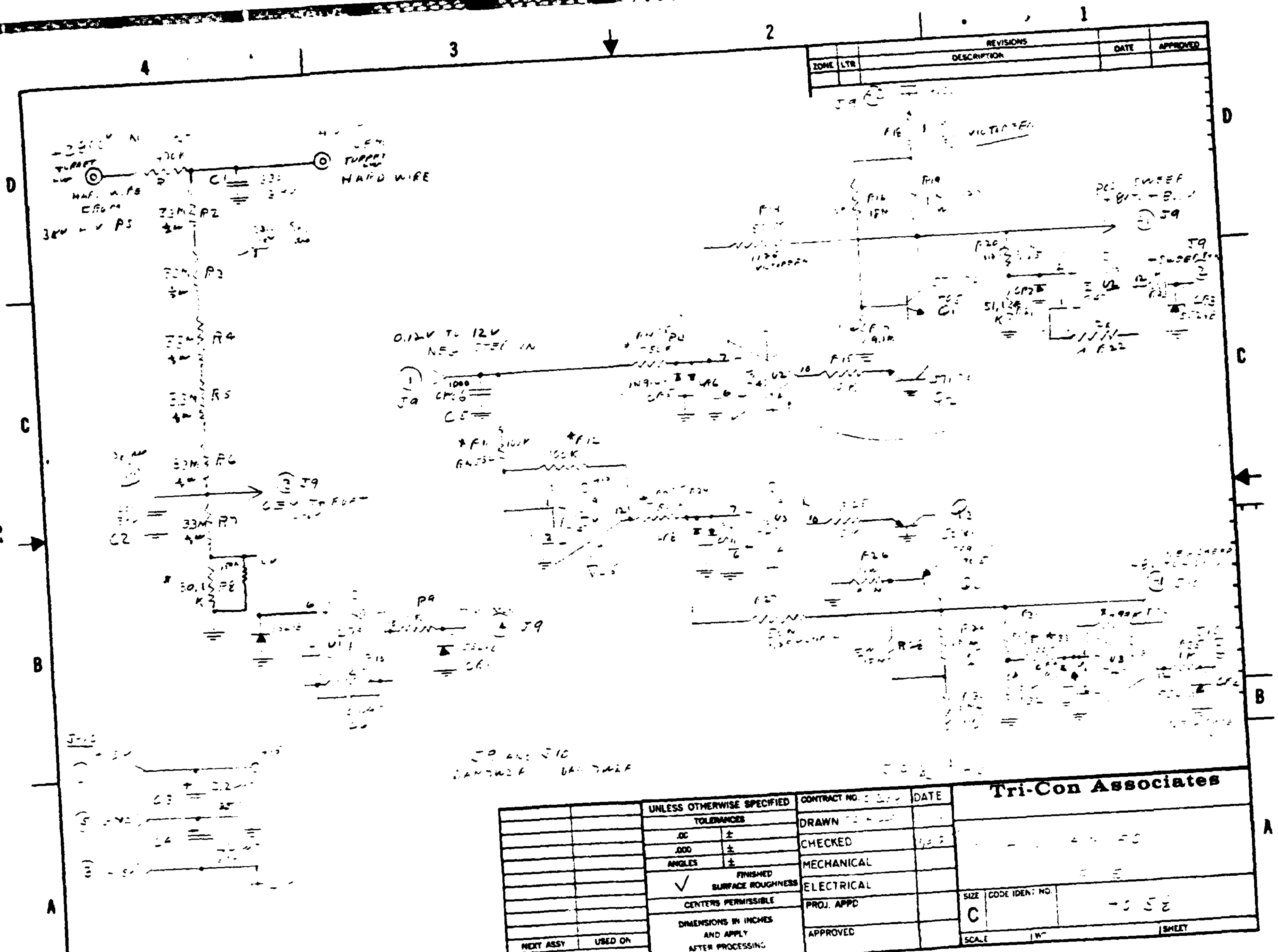
ZONE
LTR
DESCRIPTION
DATE
APPROVED
UNLESS OTHERWISE SPECIFIED
TOLERANCES
ANGLES
FINISHED SURFACE ROUGHNESS
CENTERS PERMISSIBLE
DIMENSIONS IN INCHES AND APPLY AFTER PROCESSING
CONTRACT NO.
DRAWN
CHECKED
MECHANICAL
ELECTRICAL
PROJ APPD
APPROVED
NEXT ASSY
USED ON
APPLICATION
SIZE
C
CODE IDENT NO.
SCALE
WT
SHEET
U1
U3
U4
U5
4051
STEP
0.12V TO 12V
1K
R9
NEG-STEP
53.6K
4.53K
287K
+5V
332
287
162
137

·Figure 2



REVISIONS
ZONE
LTR
DESCRIPTION
DATE
APPROVED
HARD WIRE
C1
R2
R3
R4
R5
R6
R7
C2
0.12V TO 12V
J9
C5
U2
U3
R9
F26
UNLESS OTHERWISE SPECIFIED
TOLERANCES
.00
.000
ANGLES
FINISHED SURFACE ROUGHNESS
CENTERS PERMISSIBLE
DIMENSIONS IN INCHES AND APPLY AFTER PROCESSING
NEXT ASSY
USED ON
APPLICATION
CONTRACT NO.
DATE
DRAWN
CHECKED
MECHANICAL
ELECTRICAL
PROJ. APPD
APPROVED
Tri-Con Associates
SIZE
C
CODE IDENT NO.
SCALE
SHEET

Figure 3

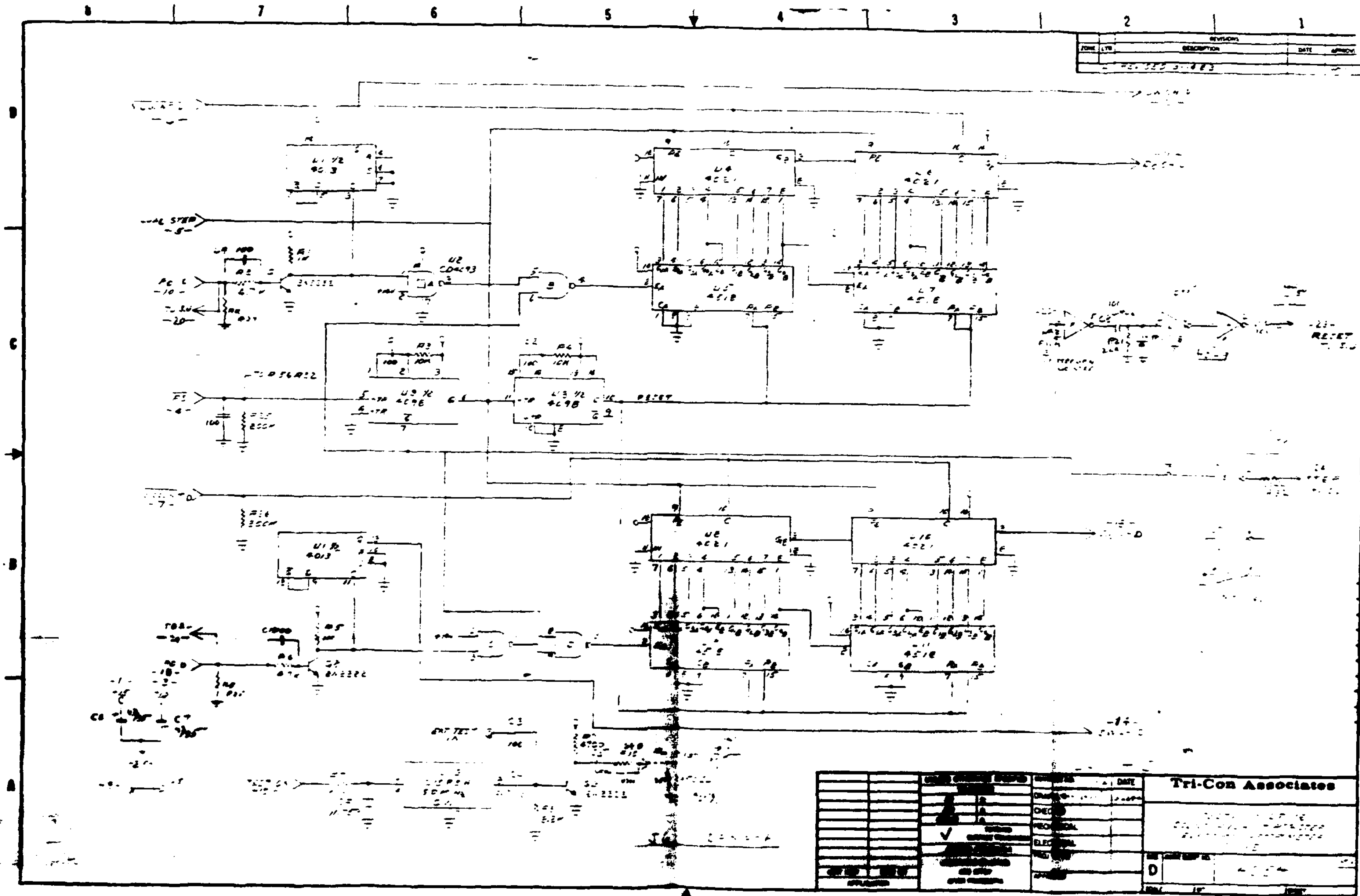


Figure 4

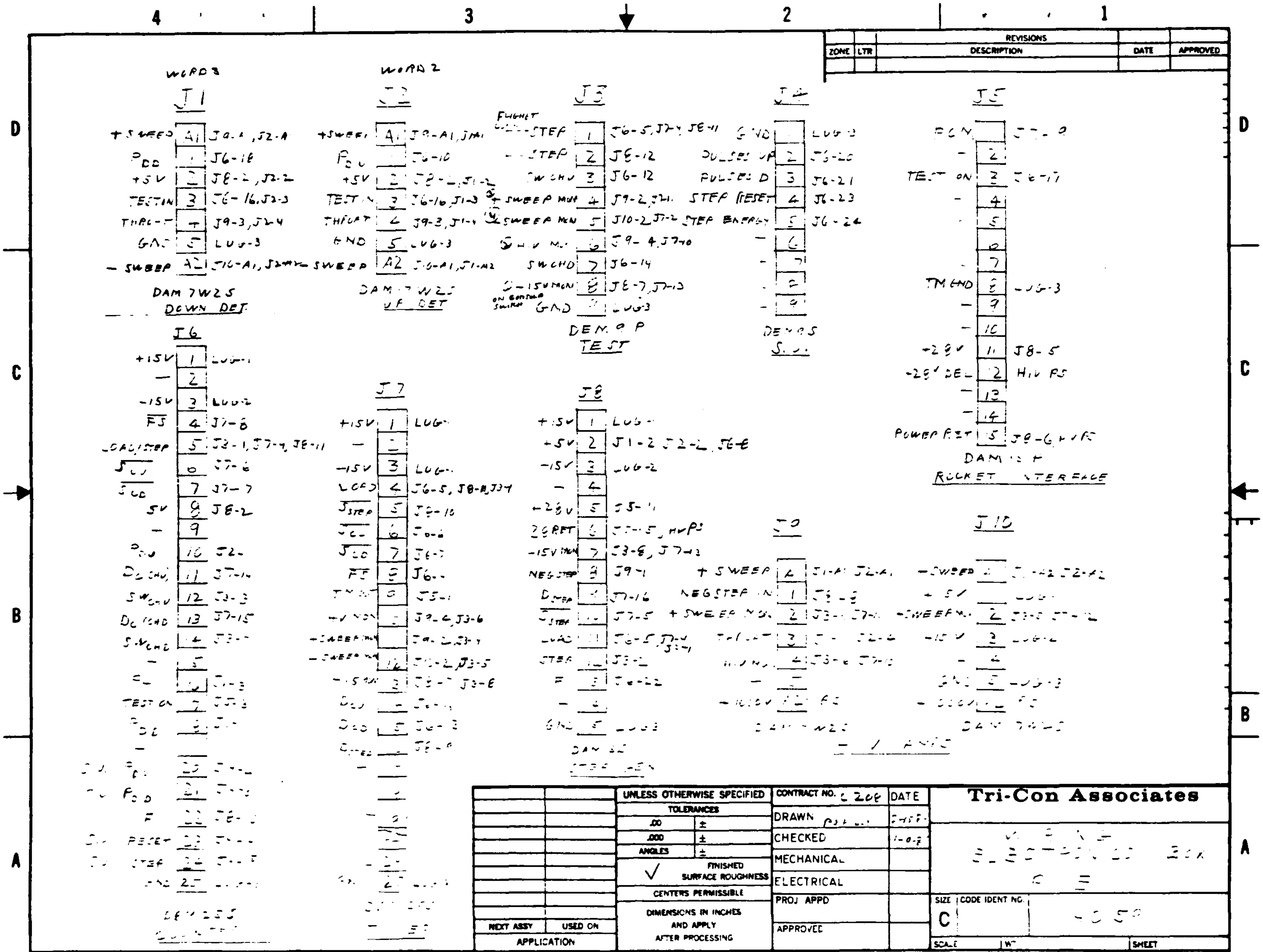

REVISIONS
ZONE
LTR
DESCRIPTION
DATE
APPROVED
WORD 3
J1
DAM 7W2S
DOWN DET
WORD 2
J2
UP DET
J3
DEM 9 P
TEST
J4
J5
ROCKET INTERFACE
J6
J7
J8
J9
J10
Tri-Con Associates
UNLESS OTHERWISE SPECIFIED
TOLERANCES
ANGLES
FINISHED SURFACE ROUGHNESS
CENTERS PERMISSIBLE
DIMENSIONS IN INCHES AND APPLY AFTER PROCESSING
CONTRACT NO.
DATE
DRAWN
CHECKED
MECHANICAL
ELECTRICAL
PROJ APPD
APPROVED
NEXT ASSY
USED ON
APPLICATION
SIZE
C
CODE IDENT NO.
SCALE
SHEET

Figure 5

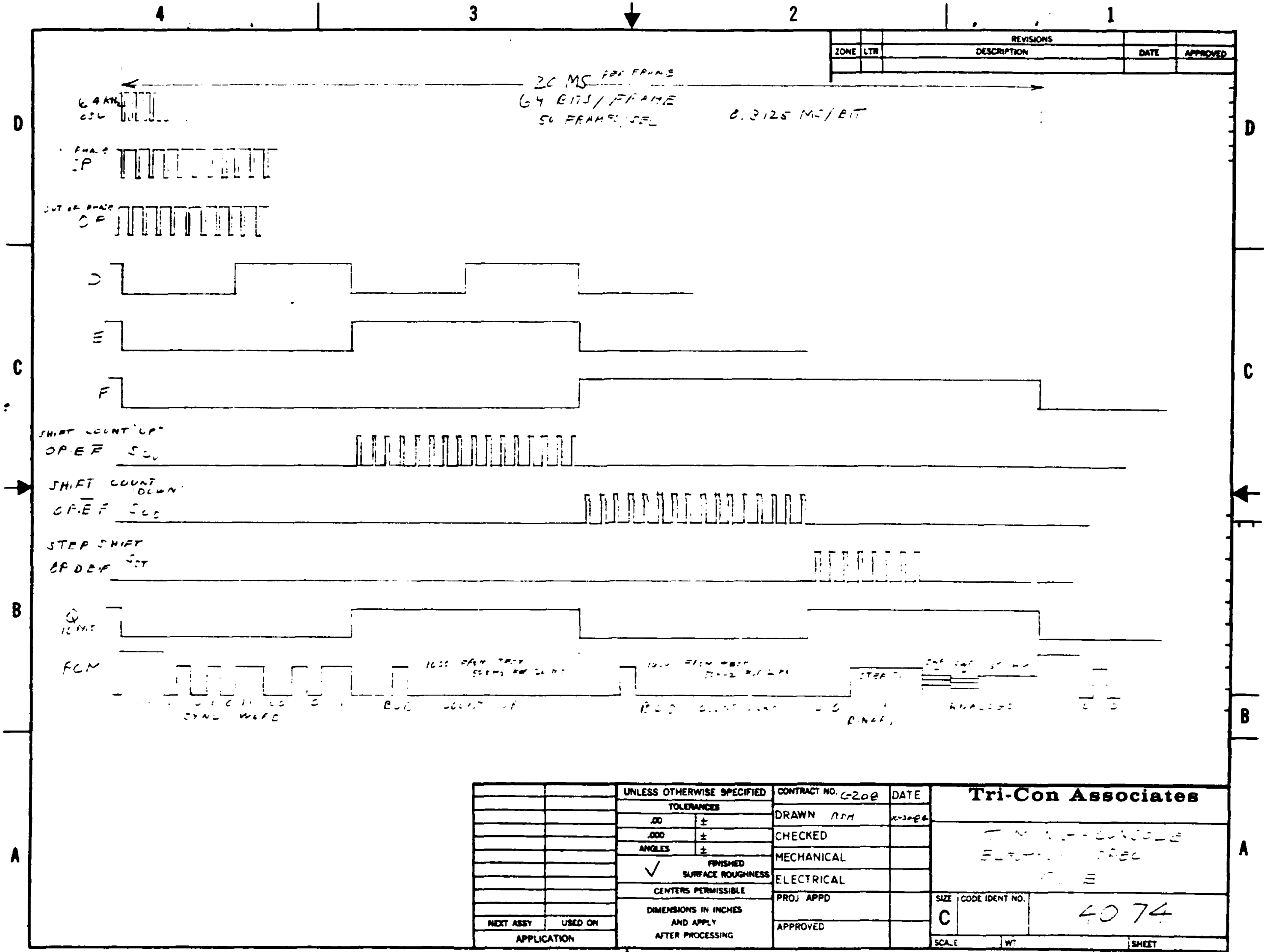
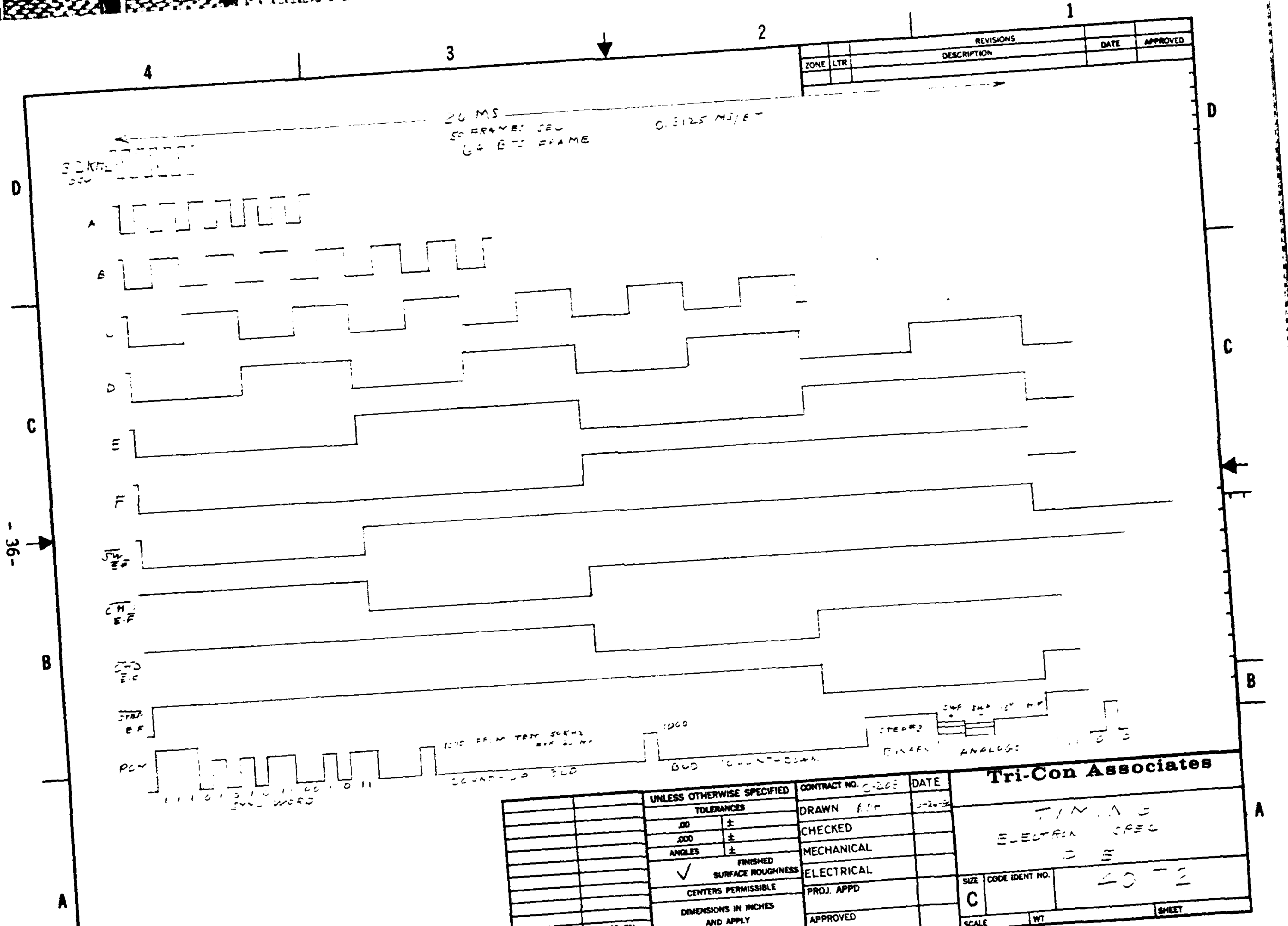

20 MS PER FRAME
64 BITS/FRAME
50 FRAMES/SEC
0.3125 MS/BIT
6.4 KHz OSC
SHIFT COUNT UP
SHIFT COUNT DOWN
STEP SHIFT
SYNC WORD
FCM
REVISIONS
ZONE
LTR
DESCRIPTION
DATE
APPROVED
UNLESS OTHERWISE SPECIFIED
TOLERANCES
.00 ±
.000 ±
ANGLES ±
FINISHED SURFACE ROUGHNESS
CENTERS PERMISSIBLE
DIMENSIONS IN INCHES AND APPLY AFTER PROCESSING
NEXT ASSY
USED ON
APPLICATION
CONTRACT NO. G-208
DATE
DRAWN RSM
CHECKED
MECHANICAL
ELECTRICAL
PROJ APPD
APPROVED
Tri-Con Associates
SIZE C
CODE IDENT NO.
4074
SCALE
WT
SHEET

Figure 6


REVISIONS
ZONE
LTR
DESCRIPTION
DATE
APPROVED
20 MS
A
B
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E
F
PCM
UNLESS OTHERWISE SPECIFIED
TOLERANCES
.00 ±
.000 ±
ANGLES ±
FINISHED SURFACE ROUGHNESS
CENTERS PERMISSIBLE
DIMENSIONS IN INCHES AND APPLY AFTER PROCESSING
NEXT ASSY
USED ON
APPLICATION
CONTRACT NO.
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ELECTRICAL
PROJ. APPD
APPROVED
Tri-Con Associates
SIZE
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CODE IDENT NO.
SCALE
WT
SHEET

Figure 7

END

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